

sub displacement of a micro-actuator.

REMARKS

Applicants acknowledge the allowance of Claims 13-15. Applicants also acknowledge that Claim 12 is allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 1-6, 10, 11 and 16-20 have been rejected under 35 U.S.C. §102(e) as being anticipated by Pease et al. (U.S. Patent No. 6,304,586). Claims 7-9 have been rejected over Pease et al. as applied to Claim 1 above, and further in view of Ohnstein et al. (U.S. Patent No. 5,929,542). Reconsideration of these claims is respectfully requested.

Pease et al. disclose a method and apparatus for modulating a tunable laser. FIG. 4 shows a top plan view of the tunable laser embodiment shown in FIG. 3. The base 300 with attached laser diode housing 330, diffraction grating 340, and fiber coupling 304 is shown. The actuator 370 is coupled to the base 300 via motor bracket 310 and strap 440. The individual components of the drive train 376 are visible and include: drive shaft 400, hub and rim 402-404, rotary flex member 406, compensating element 410, translation unit 412, cylindrical nut 414, lead screw 418, and linear flex member 420. The drive train 376 comprises rotary, linear, and arcuate portions. Generally the drive shaft converts the rotary motion of shaft 400 to linear movement of compensating block 410 and finally to arcuate movement of the tip 430 of the pivot arm to which the bracket 354 and associated retroreflector 350 are attached (See FIG. 5). This provides for the tuning of the output beam of the laser. The rotary portion of the drive train includes: shaft 400, rim 404, rotary flex member 406 and cylindrical nut 414. In the embodiment shown, the actuator 370 is a rotary actuator and specifically a stepper motor. As will be obvious to those skilled in the art, suitable alternate actuators include: piezo-electric stacks, AC/DC motors, linear stepper motors, etc. Col. 7, lines 38-60.

Ohnstein et al. disclose a micromechanical stepper motor. FIG. 2 illustrates a three phase stepper motor to replace plunger 38 and drive 30 of the high pass optical filter disclosed in FIGS. 1a and 1b of Ohnstein et al. The filter structure incorporates flexures 22, filter array 21, support spring flexures 40 and 41, stators 42, 44 and 46 and plunger 30. Support spring flexures 41 are connected to one end of plunger 30 while the opposite end of plunger 30 is connected to support

spring flexures 40 which is connected to filter array 21. Guide posts 9 operate to keep plunger 30 aligned between stators 42, 44 and 46. Col. 3, lines 24-34. The filter of FIG. 2 is stated as having a range of travel of $\pm 390 \mu\text{m}$ and a tunable range of the wavelength cutoff from 8 to 32 μm for each of the filters. Col. 4, lines 41-43.

Claim 1, as amended, is patentable by calling for a laser microassembly of the type set forth therein having, among other things, an electromechanical micro-actuator coupled to one of the diffractive element and the reflective element for selecting the wavelength from the range of wavelengths by altering the optical path of the light.

Pease et al. do not disclose a laser microassembly. Specifically, there is no disclosure in Pease et al. that the apparatus therein is of micron dimensions. Nor do Pease et al. disclose such a laser microassembly having an electro-mechanical micro-actuator. As discussed above, actuator 370 of the Pease et al. apparatus is a stepper motor, which is not of micron dimensions and thus not a microactuator as called for in Claim 1.

The apparatus disclosed in Pease et al. cannot readily be scaled to micron dimension. A change in scale of a system imposes restrictions on the design of such a system. Conventional systems cannot be arbitrarily shrunk in size and be expected to work in an analogous manner. Making electromechanical systems on a micron scale requires novel solutions to conventional engineering problems, none of which are suggested or disclosed by Pease et al. Thus the use of a micro-actuator in a tunable laser system as described in Claim 1 is inherently different from the type of system disclosed by Pease et al.

The apparatus of Pease et al. is physically too big to be commercially viable. In addition, the stepper motor disclosed in Pease et al. inherently does not provide adequate resolution to tune a laser for commercial use. In this regard, the mechanical combination of a rotary bearing for the mirror platform and a threaded nut for the lead screw mechanism of the stepper motor inherently produces errors and uncertainties in the accurate positioning of the tuning mechanism. The large size and the apparent use of a variety of high-expansion coefficient materials of the Pease et al. apparatus make accurate wavelength stability over a commercially important operating temperature range difficult if not impossible. Further, the cost of the components in the Pease design makes it commercially unsuitable.

Claims 2-12 depend from Claim 1 and are patentable for the same reasons as Claim 1 and

by reason of the additional limitations called for therein. For example, Claims 7-9 provide that the micro-actuator of Claim 1 is a micro-machined actuator.

In rejecting Claims 7-9 over Pease et al. as applied to Claim 1, and further in view of Ohnstein et al., the Examiner acknowledges that Pease et al. do not disclose a micro-machined actuator.

A proper analysis of the obviousness/nonobviousness of the claimed invention under 35 U.S.C. §103(a) requires consideration of two factors: (1) whether the prior art would have suggested to those of ordinary skill in the art that they should carry out the claimed invention; and (2) whether the prior art would also have revealed that in so carrying out the claimed invention, those of ordinary skill would have a reasonable expectation of success. Both the suggestion and the reasonable expectation of success must be founded in the prior art, not in the applicant's disclosure. *In re Sernaker*, 217 U.S.P.Q. 1, at 5 (Fed. Cir. 1983); and *In re Vaeck*, 20 U.S.P.Q.2d 1438, 1442 (CAFC 1991).

In the present case, the rejection of the claims under 35 U.S.C. §103 is in error because Pease et al. fail to provide the requisite suggestion/motivation to provide a laser microassembly of the type called for therein having, among other things, a micro-machined actuator coupled to one of the diffractive element and the reflective element. The Examiner acknowledges that Pease et al. fail to disclose a micromachined actuator. Further, there is no disclosure in Ohnstein et al. that would suggest or motivate one skilled in the art to combine a microactuator of the type set forth therein with a tunable laser of the type disclosed in Pease et al, let alone a laser microassembly of the type called for in Claim 1.

Even if a microactuator of the type disclosed in Ohnstein et al. was combined with an apparatus of the type disclosed in Pease et al., there is no suggestion or disclosure in the prior art that in so carrying out the claimed invention those of ordinary skill would have a reasonable expectation of success. The electromagnetic stepper motor of Ohnstein et al. provides a minimum step size of 1/6 of the 75 micron pitch (1) of the device or 12.5 micron steps. The total range of this actuator is +/- 390 microns or 780 microns total. Thus there are 62 total steps in the adjustment range of this actuator. The maximum force available from the Ohnstein et al. actuator can be inferred from the description to be on the order of 300 μ N. Thus, even if one could arrange a tunable laser system according to Pease et al. with a mechanical bearing platform

and a suitable coupler between the Ohnstein et al. actuator and the rotary platform, the Ohnstein et al. actuator would not be able to overcome the friction in a conventional mechanical bearing and could only provide a resolution of 62 wavelength steps during tuning. Clearly this is an unworkable and impractical tunable laser system.

In view of the foregoing, the Examiner's rejection of Claims 7-9 as being obvious over Pease et al. in view of Ohnstein et al. is improper and should be withdrawn.

Amended Claim 11 is additionally patentable by stating that the electromechanical micro-actuator of Claim 1 is an electrostatic micro-actuator. Pease et al. do not disclose an electrostatic micro-actuator.

Claim 16 is patentable for the reasons discussed above with respect to Claim 1. Claims 17-20 depend from Claim 16 and are patentable for the same reasons as Claim 16 and by reason of the additional limitations called for therein.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "Version with Markings to Show Changes Made."

In view of the foregoing, it is respectfully submitted that the claims of record are allowable and that the application should be passed to issue. Should the Examiner believe that the application is not in a condition for allowance and that a telephone interview would help further prosecution of this case, the Examiner is requested to contact the undersigned attorney at the phone number below.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

The following claims have been amended as indicated:

1. (Twice Amended) A laser [assembly] microassembly comprising a source for providing a light along an optical path with any wavelength from a range of wavelengths, a diffractive element positioned in the optical path and spaced from the source by a first distance to redirect the light, a reflective element positioned in the optical path and spaced from the diffractive element by a second distance to receive the redirected light from the diffractive element and to redirect the light back towards the diffractive element, the light being redirected by the diffractive element back towards the source, and an electromechanical micro-actuator coupled to one of the diffractive element and the reflective element for selecting the wavelength from the range of wavelengths by altering the optical path of the light.

2. (Twice Amended) The laser [assembly] microassembly of Claim 1, wherein the first distance and the second distance define an optical path length between the source and the reflective element measured in wavelengths, and wherein the optical path length remains constant over the range of wavelengths.

3. (Amended) The laser [assembly] microassembly of Claim 2, wherein the micro-actuator is coupled to the reflective element to displace the reflective element.

4. (Amended) The laser [assembly] microassembly of Claim 3, wherein the displacement comprises an angular displacement.

5. (Amended) The laser [assembly] microassembly of Claim 4, wherein the angular displacement occurs about a virtual pivot point.

6. (Amended) The laser [assembly] microassembly of Claim 4, wherein the displacement comprises a translation and a rotation.

7. (Amended) The laser [assembly] microassembly of Claim 2, wherein the micro-actuator comprises a micro-machined actuator.

8. (Amended) The laser [assembly] microassembly of Claim 7, wherein the micro-machined actuator is coupled to the reflective element.

9. (Amended) The laser [assembly] microassembly of Claim 8, wherein the reflective element comprises a retro-reflector.

10. (Twice Amended) The laser [assembly] microassembly of claim 2, wherein the range of wavelengths comprises from about 1520nm to about 1560nm.

11. (Amended) The laser [assembly] microassembly of Claim [10] 1, wherein the [wavelength is 1540nm] electromechanical micro-actuator is an electrostatic micro-actuator.

12. (Amended) The laser [assembly] microassembly of Claim 10, wherein the source comprises a Fabry-Perot laser.

16. (Twice Amended) A method for [providing] using a laser microassembly to provide light with any wavelength selected from a range of wavelengths, comprising the steps of providing the light along an optical path, providing a diffractive element in the optical path to diffract the light, providing a reflective element in the optical path to reflect the light and selecting a particular wavelength of light from the range of wavelengths by altering the optical path through displacement of a micro-actuator.